



## Discussion on the technical system of protection and restoration of historical district ——Taking the protection and renovation of Qingguo Lane Historic District in Changzhou as an example

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### ABSTRACT

The Qingguo Lane district in Changzhou, situated along the ancient Grand Canal, preserves notable historical structures and the city's traditional essence. It embodies layered historical narratives, constituting a vibrant community. Conservation here addresses intricate challenges, including historical element identification, street pattern analysis, restoration strategy categorization, infrastructure enhancement, structural safety improvement, and fire safety. Based on thorough surveys and assessments of its traditional buildings, the district has developed four clear preservation and renovation strategies with specific application scopes. A compilation of Changzhou's architectural traits and artisanal skills has been created, providing technical guidelines for the city's historical restoration projects. The Qingguo Lane project also spearheads research into adaptive preservation technologies for old buildings, focusing on timber and wall reinforcement, fire safety, and functional adaptability. It seeks effective preventive conservation methods for architectural heritage from a technical perspective.

The Qingguo Lane, situated on the north bank of the ancient Grand Canal, a World Cultural Heritage site, stretches for 930 meters in length. Over the centuries, Qingguo Lane has preserved historical relics from various periods, and is considered the quintessence of Changzhou's historical culture. It is one of the few areas in Changzhou that retains significant historical buildings and architectural styles. The entire district encapsulates and authentically conveys a multitude of information about Changzhou's urban economy, politics, culture, architectural arts, urban appearance, living conditions, and lifestyle since the Ming and Qing dynasties. It serves as a vessel for Changzhou's historical information and a "specimen" of the city's traditional architectural style.

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**Fig. 1.** Floor plan of Qingguo Lane Historic District



**Fig. 2.** Aerial view of Qingguo Lane Historic District

The Qingguo Lane Historic District is distinguished by its culture of eminence, having fostered a multitude of accomplished individuals in the realms of literature and strategic thought. This district has been a cradle for talents across a spectrum of disciplines, including philosophy, politics, literature, art, education, and science. It enjoys the prestigious accolade of being the "Premier Lane of Eminence in Jiangnan," reflecting its significant contribution to the region's intellectual and cultural legacy.



**Fig. 3.** Outstanding talents from Qingguo Lane Historic District

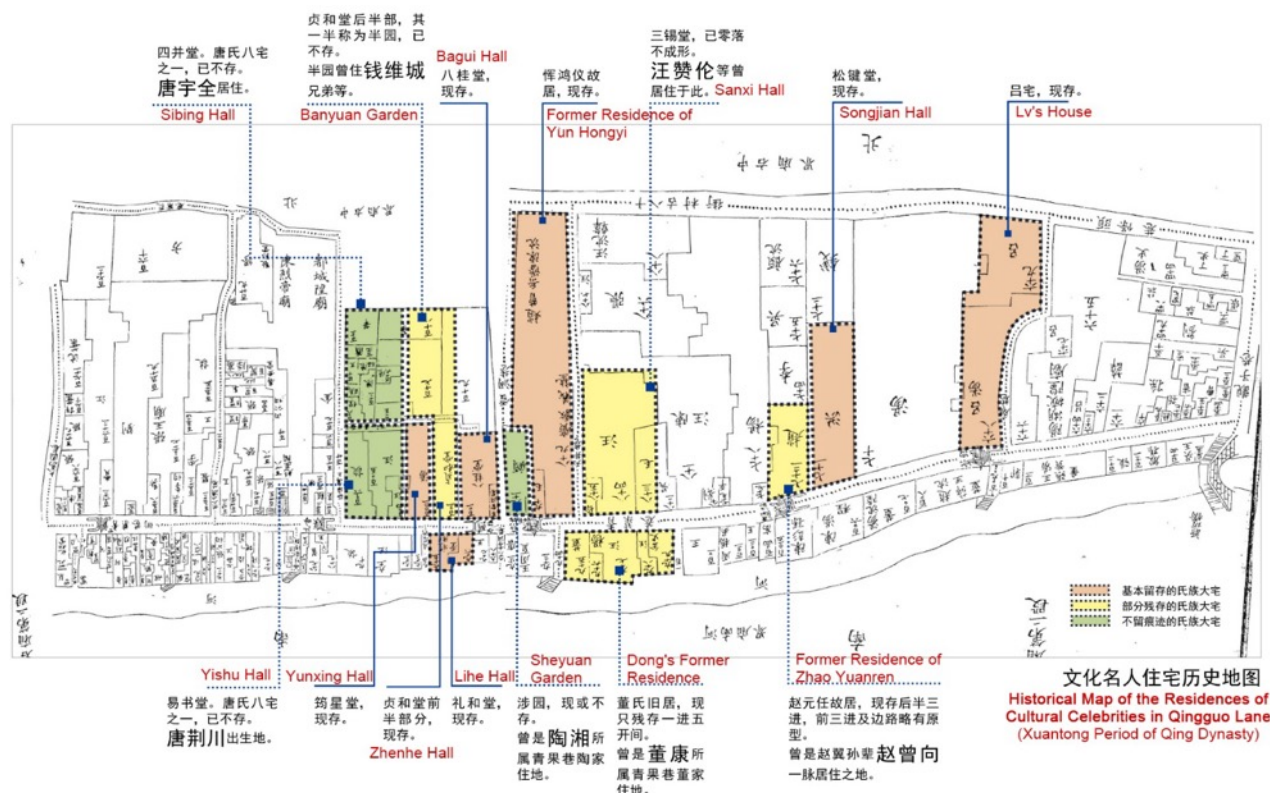


Fig. 4. Former residences of celebrities in Qingguo Lane Historic District

Within the Qingguo Lane Historic District, the wooden remnants exhibit a stratified record of construction and renovation from various eras, encapsulating the district's architectural evolution. Preserving this 'layered history' is paramount for the holistic conservation of the area. A scientifically rigorous and precise evaluation of the old buildings' quality and style has delineated four distinct preservation and restoration approaches: restoration, conservation and enhancement, renovation, and demolition. The applicability of each method has been clearly defined, and a meticulous, small-scale, and incremental implementation model has been adopted to conduct the preservation efforts with care and precision.

The preservation approach underscores the significance of historical continuity, advocating for a research-led methodology that maintains the integrity of historical strata and advocates for a balanced approach between conservation and utilization. By integrating conservation principles with the specific contexts of various heritage elements, tailored strategies and technical interventions are devised. These are grounded in scholarly investigation, with the ultimate aim of applying physical and engineering solutions that are both appropriate and effective.



Fig. 5. Maintenance site of Qingguo Lane Historic District



The preservation strategy is anchored in the enduring narrative of history, with a research-centric approach that values the preservation of historical strata and the harmonious integration of conservation with practical use. It involves aligning the overarching principles of conservation with the unique characteristics of each heritage item, formulating well-considered countermeasures and technical strategies. These strategies are informed by scholarly research and are executed through tangible and engineering initiatives, aiming to achieve the ultimate objectives of heritage conservation.

Initially, a comprehensive examination is undertaken to assess the current land use, historical and cultural landmarks, transportation networks, infrastructure, demographic and socioeconomic profiles, and the historical functions within the Qingguo Lane historical and cultural block and its environs. This includes an exhaustive analysis of the street patterns and urban fabric. Concurrently, a meticulous survey is performed on the existing old buildings within the block, examining their age, floor count, condition, structural integrity, architectural style, and land ownership.

Furthermore, a broad solicitation of public opinion is executed through various means, including organizing numerous discussions and consultations with local residents, engaging with professional organizations and experts, and conducting both on-site and online surveys to gather a wide range of perspectives. This approach ensures a well-informed and inclusive strategy for the conservation and revitalization of the area.

In the Qingguo Lane historical and cultural district, the inventory of cultural heritage is rich, comprising 1 national-level protected cultural relic, 7 at the provincial level, 2 at the municipal level, and 4 designated historical buildings. The district is home to approximately 61 cultural relics categorized under the Sanpu cultural heritage sites and high-value structures. The land designated for the restoration of buildings spans 5.36 hectares, with the refurbished construction area totaling approximately 33,000 square meters. These restored structures are predominantly traditional wooden residences, located along both sides of Qingguo Lane in the southern part of the district.

In contrast, the northern part of the district features infill plots, predominantly occupied by newly constructed commercial buildings. Like many urban neighborhoods, Qingguo Lane exemplifies a blend of the old and the new, with layers of construction and renovation from various historical periods. A case in point is the Zhenhetang courtyard, which showcases a fusion of renovations from the Ming, Qing dynasties, and the Republic of China periods, authentically reflecting the area's historical evolution.



Fig. 6. Comparison of building courtyards before and after restoration

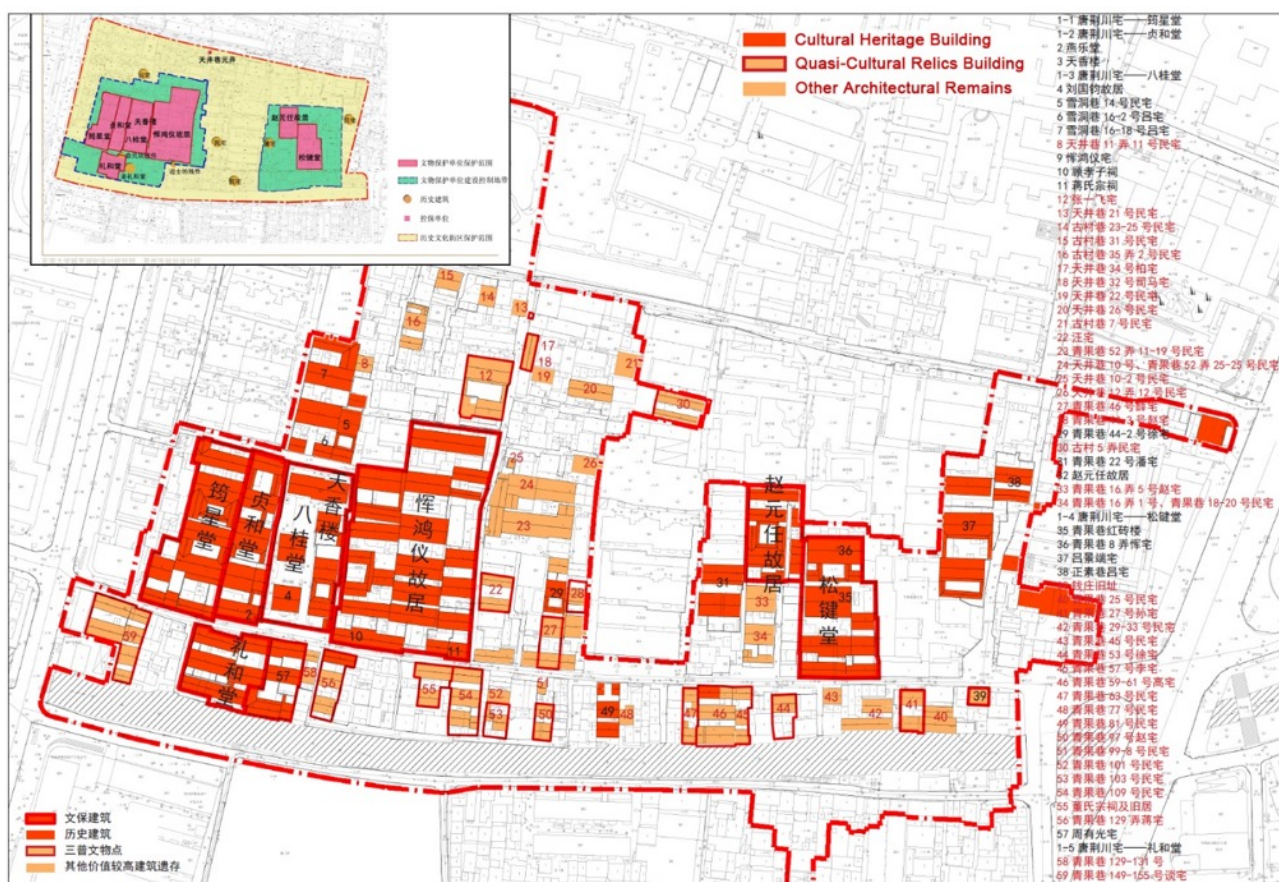


Fig. 7. Cultural relics buildings of different periods and levels

In the subsequent phase, a meticulous and scientifically rigorous evaluation was conducted to assess the quality and stylistic integrity of the historic buildings within Qingguo Lane. This evaluation served as the foundation for devising four distinct approaches to the conservation and restoration of these edifices: restoration, preservation and enhancement, adaptive reuse, and, where necessary, demolition. Each of these methodologies was carefully delineated with a clear scope of application to ensure that the interventions are contextually appropriate and preserve the architectural heritage effectively.

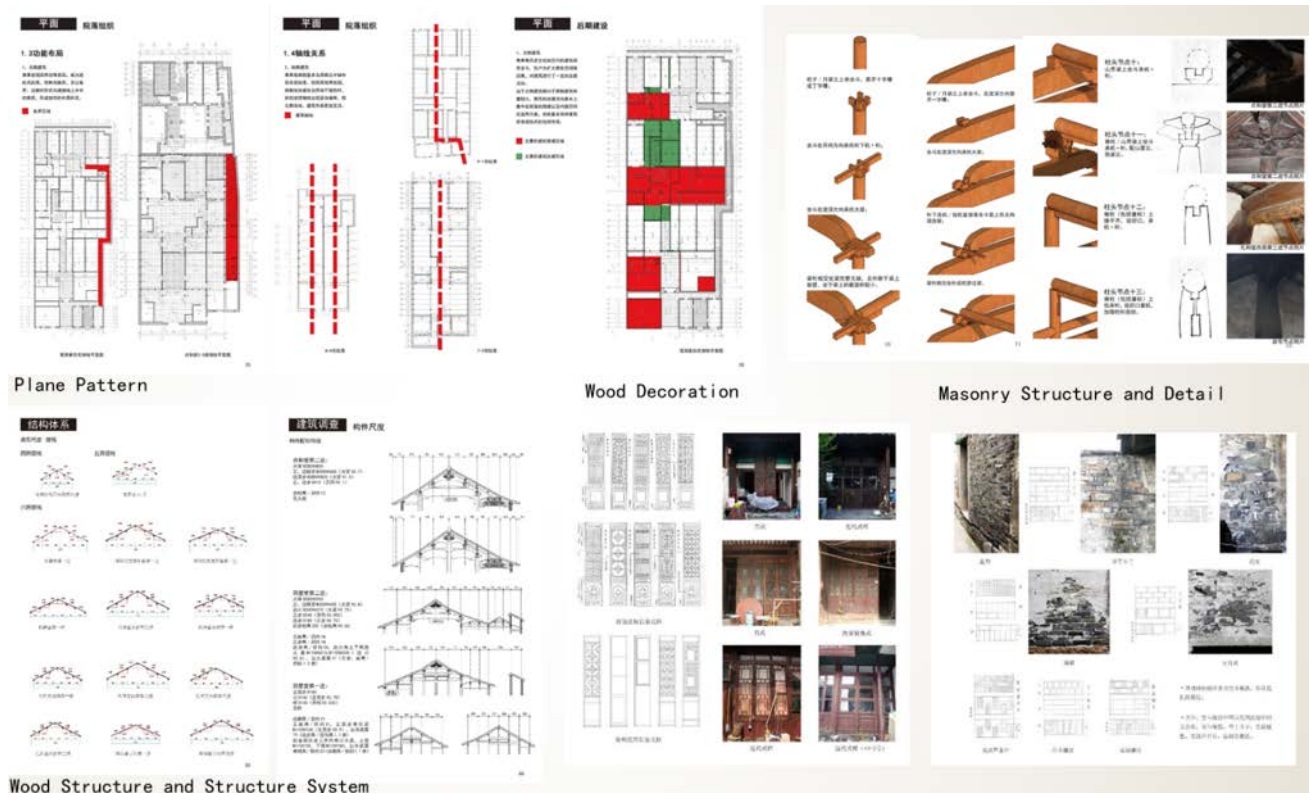
Through meticulous research, cartographic documentation, and extensive interviews, the "Changzhou Historical Building Restoration Technical Guidelines" have been established. This marks the inaugural comprehensive and scientific dissection of Changzhou's traditional architectural elements, epitomized by Qingguo Lane. The objective was to meticulously catalog and encapsulate the quintessential architectural traits that define the city's heritage.



**Fig. 8.** Historical Building Repair Technical Guidelines

Selected examples were meticulously surveyed and mapped to create detailed vertical sections and large-scale samples of the buildings. By analyzing the collected data and photographs, the study distilled the quintessential characteristics of Changzhou's traditional architecture, including the layout, structural system, beam configuration, roof and wall treatments, and decorative elements. This systematic approach provides valuable insights and serves as a robust framework for guiding the conservation, repair, and restoration efforts of traditional buildings within the community.





**Fig. 9.** Historical Building Repair Technical Guidelines

To discern the temporal characteristics, dating can be achieved not solely through the scale and form but also through the application of material analysis to substantiate the assessment. The second principal chamber within Zhenhe Hall, known as "Phoebe Hall," has been examined through the sampling and species identification of its wooden architectural elements. It was determined that the construction materials encompass nanmu (a type of Chinese timber), pine, and fir. These findings, when juxtaposed with the morphological features of traditional components, indicate a concordance with the wood species transitions observed during the Ming and Qing Dynasties. The stratigraphic rationale of the reconstruction period is thus distinctly elucidated.

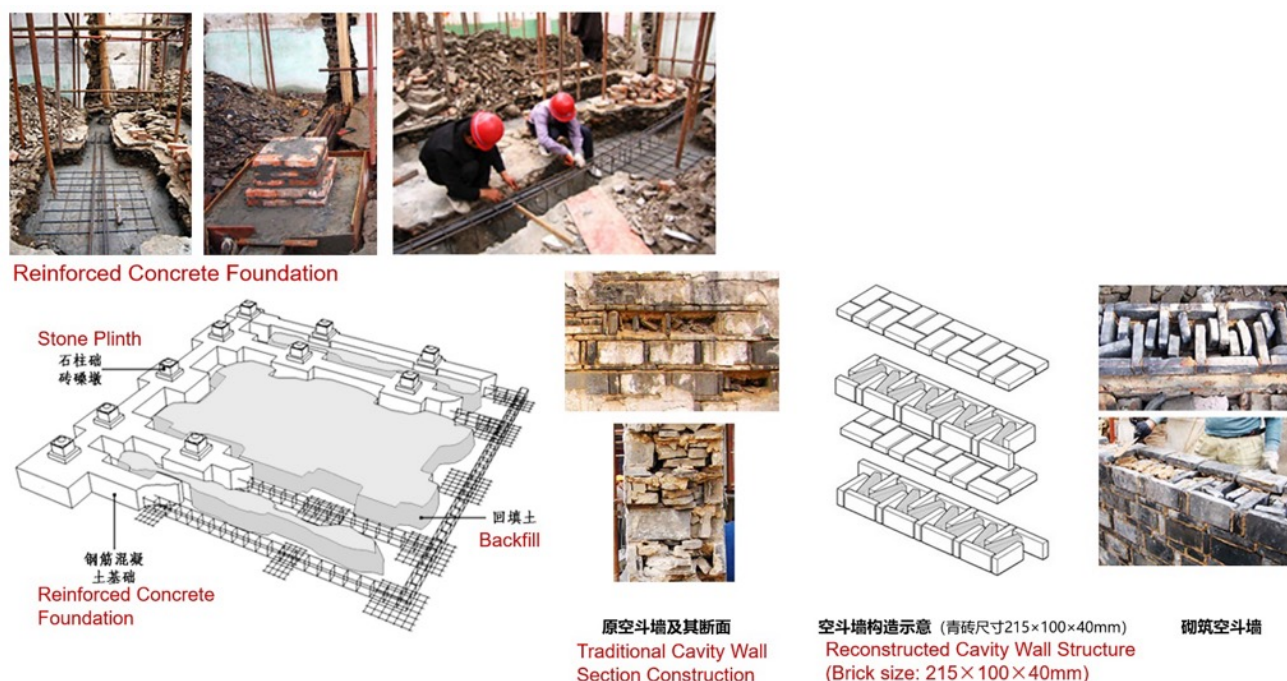


**Fig. 10.** Showcasing the superposition of historical information from different periods is the best manifestation of its authenticity

Preserving the integrity of the authentic structure while enriching its cultural significance, the primary challenge in the conservation efforts of the district lies in the mitigation of safety hazards. Utilizing the preservation and restoration of Qingguo Lane as a pivotal opportunity, we aim to reinforce the wooden framework and masonry, as well as to enhance fire safety measures. Concentrating on three key areas—expanding capacity, enhancing the adaptability of functional transformation—we have engaged in research on innovative adaptive technologies for the conservation and restoration of historic buildings. These technologies are designed to balance the imperatives of historical preservation with the demands of sustainable and viable reuse.

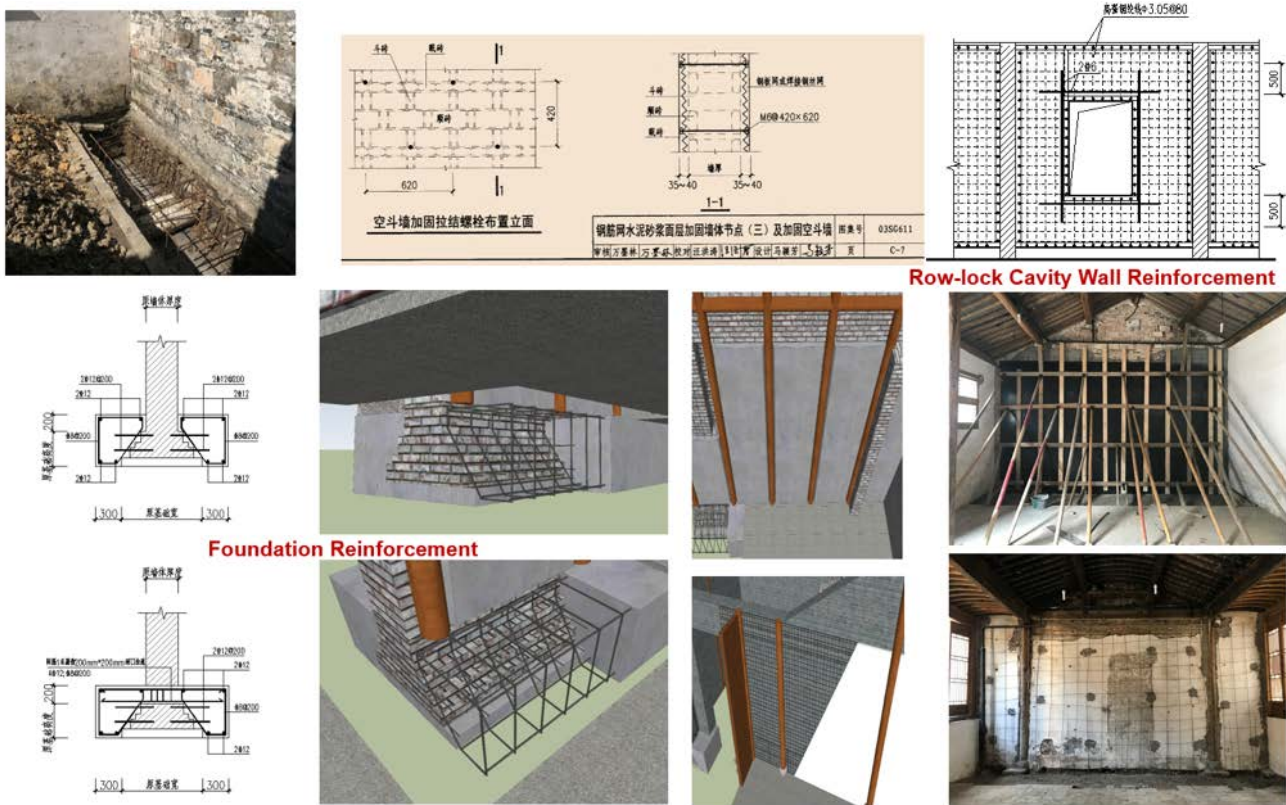
For instance, concerning the reinforcement of hollow brick walls, the conventional approach to addressing walls that failed to meet seismic criteria involved dismantling them and reconstructing the reinforced concrete foundation. This was done to bolster the structural integrity and stability of the walls. Alternative methods include infilling the voids with bricks and integrating additional structural elements such as columns and ring beams to enhance their load-bearing capacity and resilience.





**Fig. 11.** Row-lock Cavity Wall Reinforcement under modern construction technology

During the restoration of Qingguo Lane, a variety of strategies were employed to preserve the authenticity of the historic walls to the greatest extent possible. To address the wall cracks resulting from uneven settlement, changes in building functions, and increased usage loads, reinforced concrete was utilized. Specifically, the large-section method was applied to strengthen the brick foundation. Considering the suboptimal structural form of the cavity wall, the low strength of the masonry mortar, and severe deterioration due to alkali attack, a reinforcement method involving steel strand mesh and plywood was implemented from within the wall to enhance its quality, load-bearing capacity, and overall integrity. Additionally, for walls with an inclination exceeding specified limits, comprehensive rectification of the overall deviation was carried out.



**Fig. 12.** Row-lock Cavity Wall Reinforcement measures based on the principle of minimal intervention



**Fig. 13.** Row-lock Cavity Wall Rectification based on the principle of minimal intervention

Firefighting within historic districts is confronted with three principal challenges. Initially, the prevalent use of combustible construction materials results in low fire resistance and high fire loads. Secondly, the close proximity of buildings facilitates the rapid spread of fires, leading to extensive conflagrations. Thirdly, the high density of structures coupled with inadequate road infrastructure and insufficient water resources complicates firefighting and rescue efforts.



To tackle these issues, it is imperative to conduct on-site investigations and perform fire risk assessments prior to the commencement of fire protection design. These assessments should inform the development of targeted mitigation strategies. In alignment with relevant regulations, a thorough review of existing issues must be undertaken, encompassing the fire resistance rating, overall layout, fire compartmentation, safe evacuation routes, functional usage, and fire protection installations. An analysis of the inherent design limitations should be conducted, followed by the proposition of effective countermeasures.

Under the guidance of the "Regulations on the Protection of Historic and Cultural Cities in Changzhou," the "Fire Protection Design and Safeguard Measures Plan for the Qingguo Lane Historic and Cultural Block in Changzhou" has been meticulously compiled. This plan delineates adaptive technical strategies that cater to both the preservation and utilization aspects of the historical district. Jiangsu Jinling Cultural Tourism Development Co., Ltd. has taken on the mantle of routine safety management, assembling a comprehensive fire safety team for Qingguo Lane. This team is structured on a grid basis and comprises full-time fire safety officers, part-time fire safety officers, volunteer fire safety officers, and merchant fire safety administrators. Equipped with specialized fire protection facilities and equipment, they have successfully transformed Qingguo Lane into an exemplary case for the revitalization and utilization of historical and cultural blocks in Jiangsu Province, as well as for the execution of fire inspection and management work.

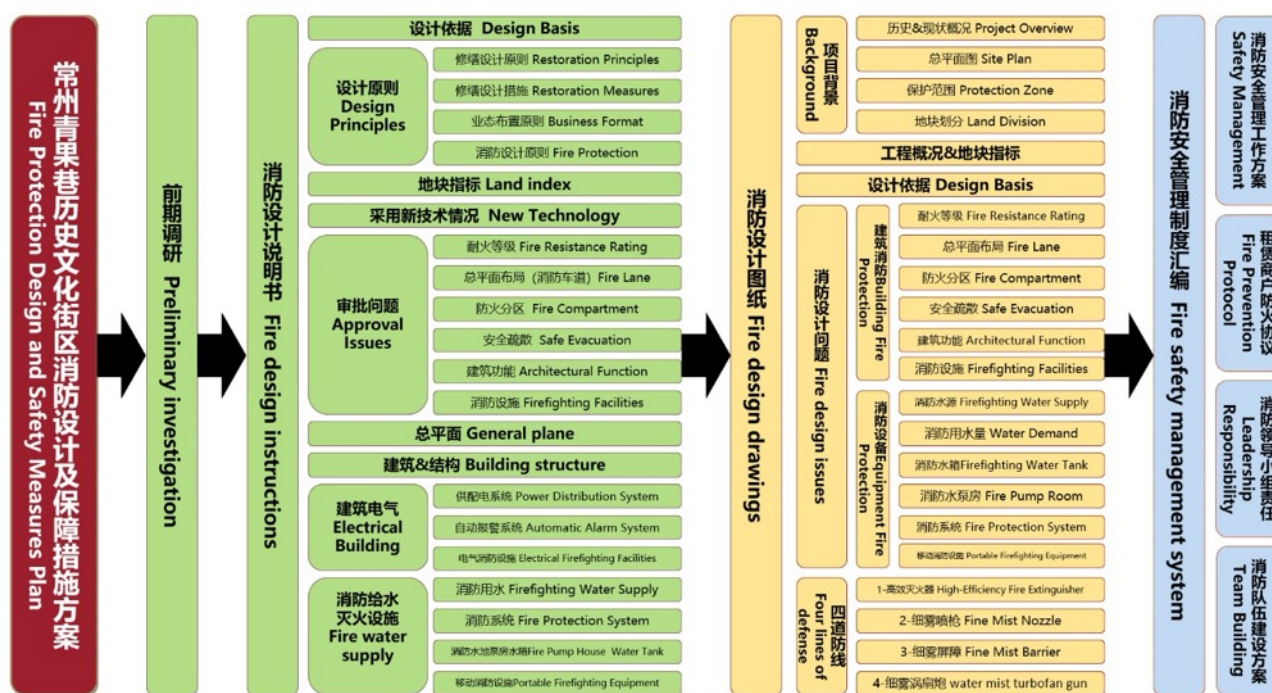


Fig. 14. Changzhou Qingguo Lane Historical and Cultural Block  
Fire Protection Design and Safety Measures Plan

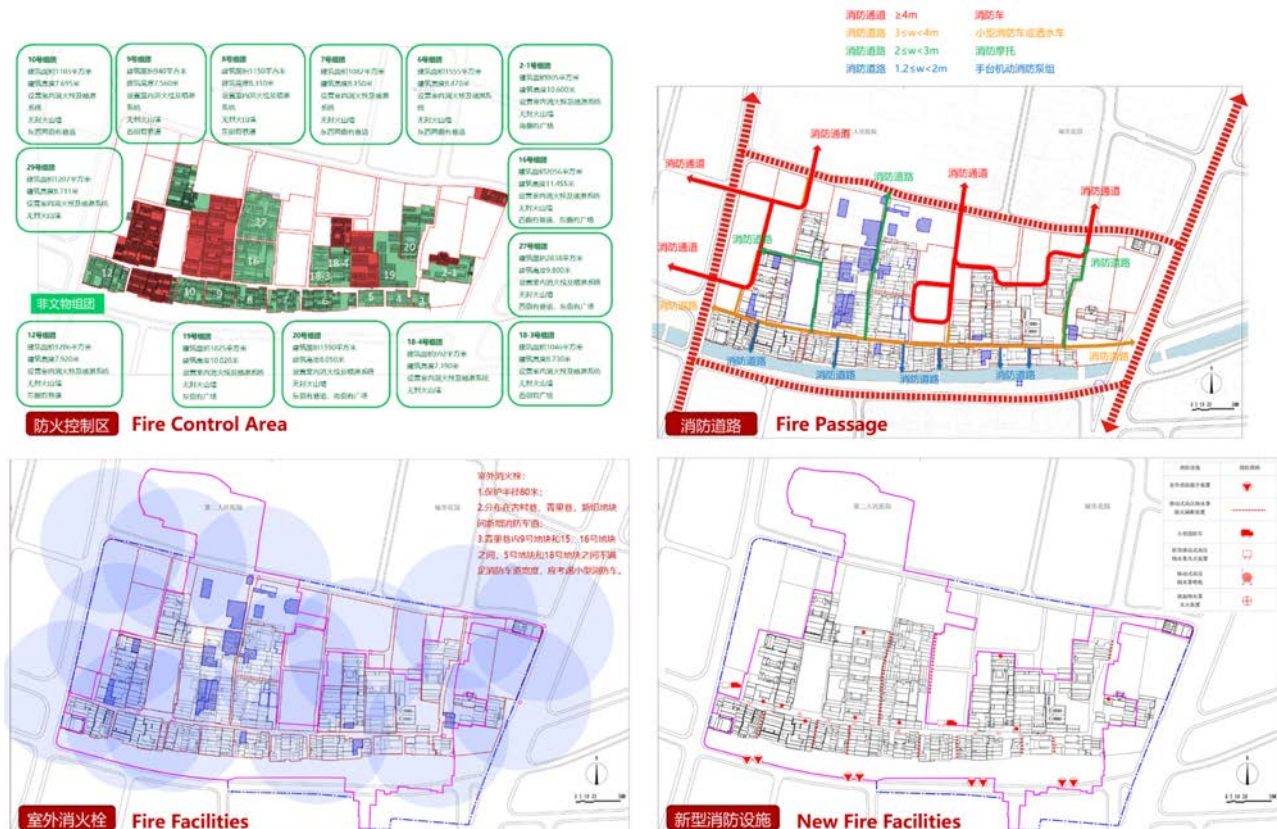
The support plan meticulously addresses fire protection design challenges and strategies within historical neighborhoods. It establishes fire prevention teams to manage and contain the scope of potential fires, and develops fire lanes in accordance with the delineation of fire control zones and fire prevention team areas, thereby enhancing conditions for fire rescue operations. Additionally, the plan incorporates the introduction of new mobile facilities and equipment to bolster firefighting capabilities.

The introduction of innovative firefighting technologies includes the deployment of mobile high-pressure water mist fire-blocking partitions, referred to as fine mist barriers. These systems are capable of swiftly creating fire-resistant and smoke-suppressing water mist zones, effectively遏制 the propagation of fire. Additionally, the plan incorporates mobile high-pressure water mist extinguishing



equipment, such as fine mist spray guns and fine mist turbofan cannons, which are designed to tackle the challenges of limited access and inadequate water and electricity supply in historic structures without causing damage to the buildings themselves.

Concurrently, it is essential to enforce the pertinent neighborhood management systems, establish a dedicated fire safety officer team, and institute regular fire safety inspections. This framework also involves the development of fire emergency protocols and the routine conduct of fire drills to ensure readiness and effectiveness in response to potential fire incidents.



**Fig. 15.** Fire Protection Design and Guarantee Measures Plan for the Historical and Cultural District of Qingguo Lane

## Four-Line Defense Firefighting Solution



## Firefighting Equipment List

青果巷一期消防专用设备清单

序号	车辆名称	数量	备注	放置位置
1	小型消防车	1	1号	东广场
2	小型消防车	1	2号	东广场
3	消防供水车	1	1号	东广场
4	消防供水车	1	2号	东广场
5	轻型移动式高压细水雾灭火装置	1	1台	史良故居
6	轻型移动式高压细水雾灭火装置	1	1台	史良故居
7	轻型移动式高压细水雾灭火装置	1	1台	史良故居
8	轻型移动式高压细水雾灭火装置	1	1台	史良故居
9	移动式高压细水雾灭火装置	1	1台	史良故居
10	移动式高压细水雾灭火装置	1	1台	史良故居
11	移动式高压细水雾灭火装置	1	1台	史良故居
12	移动式高压细水雾灭火装置	1	1台	史良故居
13	移动式高压细水雾灭火装置	3	3台	史良故居
14	移动式高压细水雾灭火装置	3	3台	史良故居
15	移动式高压细水雾灭火装置	3	3台	史良故居
16	消防泵	1	1台	史良故居
17	消防泵	1	1台	史良故居
18	消防泵	1	1台	史良故居



Fig. 16. Mobile Firefighting Facilities

## Full-Time Fire Brigade

### ■ 街区专职消防队



## Part-Time Fire Brigade

### ■ 街区兼职消防队



## ■ 商户消防志愿者 Volunteer Firefighter

## ■ 消防应急预案及演练 Fire Emergency Response Plan and Drill

Fig. 17. Historic District Fire Management System





**Fig. 18.** Creating a New Sample for the Revitalization and Development of Old City

Following the protection and restoration efforts, Qingguo Lane has preserved its traditional roles as a residential and commercial hub, evolving into a complex that showcases the charm of ancient canals and the serene beauty of expansive, historic gardens. It embodies the essence of ancient canal civilization and the traditional residential culture of Changzhou. By integrating tourism and other functions, the district has become a historical and cultural block that reflects the ancient city's culture, exhibits its architectural style, and offers residents the benefits of convenient living conditions, comprehensive infrastructure, and quintessential Jiangnan water town scenery. The revitalization of Changzhou's old city uses the Qingguo Lane historical and cultural district as a case study to craft an exemplary narrative of the harmonious integration of "urban renewal" with "historical and cultural preservation."